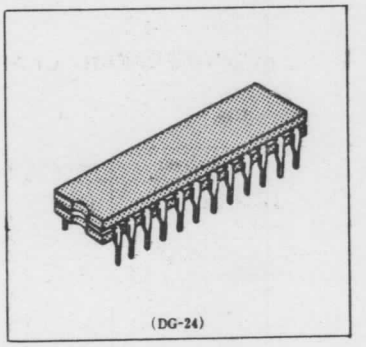
HM6116L-2, HM6116L-3, HM6116L-4

2048-word×8-bit High Speed Static CMOS RAM

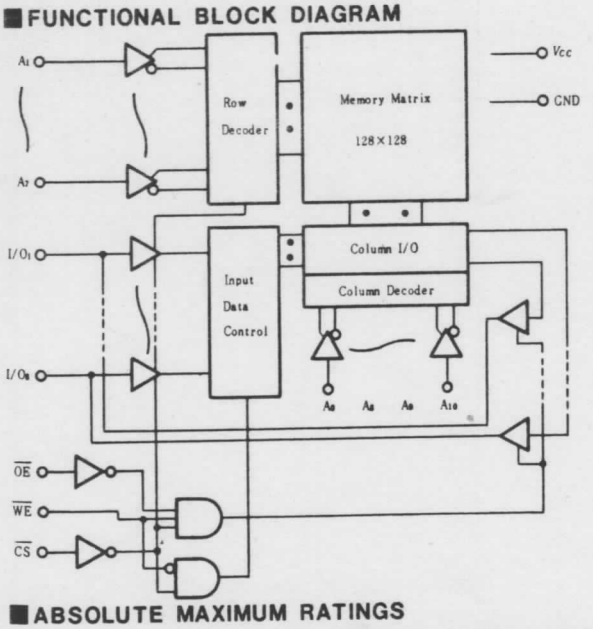
■FEATURES

- Single 5V Supply and High Density 24 Pin Package
- High Speed: Fast Access Time 120ns/150ns/200ns (max.)
- Low Power Standby and Standby: 20μW (typ.)
- Low Power Operation; Operation: 160mW (typ.)
- Completely Static RAM: No clock nor Timing Strobe Required
- Directly TTL Compatible: All Input and Output
- Pin Out Compatible with Standard 16K EPROM/MASK ROM
- Equal Access and Cycle Time
- Capability of Battery Back up Operation

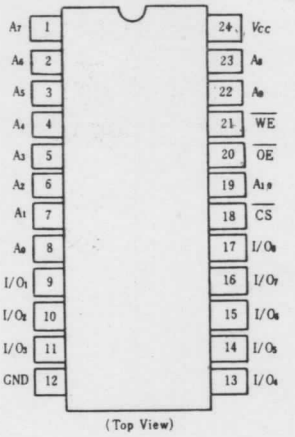


(DG-24)

■FUNCTIONAL BLOCK DIAGRAM



■PIN ARRANGEMENT



(Top View)

■ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Rating	Unit
Voltage on Any Pin Relative to GND	V_T	−0.5* to +7.0	V
Operating Temperature	T_{opr}	0 to +70	°C
Storage Temperature	T_{stg}	−65 to +150	°C
Temperature Under Bias	T_{bias}	−10 to +85	°C
Power Dissipation	P_T	1.0	W

* Pulse Width 50ns : −1.0V

■TRUTH TABLE

$\overline{CS}$	$\overline{OE}$	$\overline{WE}$	Mode	V_{CC} Current	I/O Pin	Ref. Cycle
H	×	×	Not Selected	I_{SB}, I_{SB1}	High Z	
L	L	H	Read	I_{CC}	Dout	Read Cycle (1)~(3)
L	H	L	Write	I_{CC}	Din	Write Cycle (1)
L	L	L	Write	I_{CC}	Din	Write Cycle (2)

■ RECOMMENDED DC OPERATING CONDITIONS (Ta=0 to +70°C)

Item	Symbol	min	typ	max	Unit
Supply Voltage	V_{CC}	4.5	5.0	5.5	V
	GND	0	0	0	V
Input Voltage	V_{IH}	2.2	3.5	6.0	V
	V_{IL}	−1.0*	—	0.8	V

* Pulse Width: 50ns, DC: V_{IL} min = −0.3V

■ DC AND OPERATING CHARACTERISTICS (V_{CC}=5V ±10%, GND=0V, Ta=0 to +70°C)

Item	Symbol	Test Conditions	HM6116L/P-2			HM6116L/P-3/-4			Unit
			min	typ*	max	min	typ*	max	
Input Leakage Current	$\lvert I_{LI} \rvert$	V_{CC}=5.5V, V_{in}=GND to V_{CC}	—	—	2	—	—	2	μA
Output Leakage Current	$\lvert I_{LO} \rvert$	$\overline{CS}=V_{IH}$ or $\overline{OE}=V_{IH}$, $V_{I/O}$=GND to V_{CC}	—	—	2	—	—	2	μA
Operating Power Supply Current	I_{CC}	$\overline{CS}=V_{IL}$, $I_{I/O}$=0mA	—	35	70	—	30	60	mA
	I_{CC1}**	V_{IH}=3.5V, V_{IL}=0.6V, $I_{I/O}$=0mA	—	30	—	—	25	—	mA
Average Operating Current	I_{CC2}	min. cycle, duty=100%	—	35	70	—	30	60	mA
Standby Power Supply Current	I_{SB}	$\overline{CS}=V_{IH}$	—	4	12	—	4	12	mA
	I_{SB1}	$\overline{CS} \geq V_{CC}-0.2V$, $V_{in} \geq V_{CC}-0.2V$ or $V_{in} \leq 0.2V$	—	4	100	—	4	100	μA
Output Voltage	V_{OL}	I_{OL}=4mA	—	—	0.4	—	—	—	V
		I_{OL}=2.1mA	—	—	—	—	—	0.4	
	V_{OH}	I_{OH}=−1.0mA	2.4	—	—	2.4	—	—	V

* : V_{CC}=5V, Ta=25°C
** : Reference Only

■ AC CHARACTERISTICS (V_{CC}=5V ±10%, Ta=0 to +70°C)

● AC TEST CONDITIONS

Input Pulse Levels: 0.8 to 2.4V
Input Rise and Fall Times: 10 ns
Input and Output Timing Reference Levels: 1.5V
Output Load: 1TTL Gate and C_L = 100pF (including scope and jig)

● READ CYCLE

Item	Symbol	HM6116L-2		HM6116L-3		HM6116L-4		Unit
		min	max	min	max	min	max	
Read Cycle Time	t_{RC}	120	—	150	—	200	—	ns
Address Access Time	t_{AA}	—	120	—	150	—	200	ns
Chip Select Access Time	t_{ACS}	—	120	—	150	—	200	ns
Chip Selection to Output in Low Z	t_{CLZ}	10	—	15	—	15	—	ns
Output Enable to Output Valid	t_{OE}	—	80	—	100	—	120	ns
Output Enable to Output in Low Z	t_{OLZ}	10	—	15	—	15	—	ns
Chip deselection to Output in High Z	t_{CHZ}	0	40	0	50	0	60	ns
Chip Disable to Output in High Z	t_{OHZ}	0	40	0	50	0	60	ns
Output Hold from Address Change	t_{OH}	10	—	15	—	15	—	ns

● WRITE CYCLE

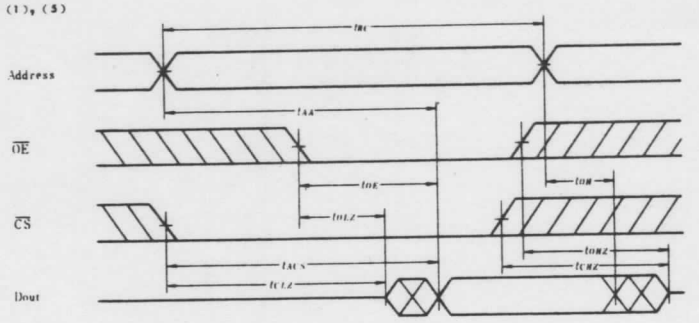
Item	Symbol	HM6116L-2		HM6116L-3		HM6116L-4		Unit
		min	max	min	max	min	max	
Write Cycle Time	t_{WC}	120	—	150	—	200	—	ns
Chip Selection to End of Write	t_{CW}	70	—	90	—	120	—	ns
Address Valid to End of Write	t_{AW}	105	—	120	—	140	—	ns
Address Set Up Time	t_{AS}	20	—	20	—	20	—	ns
Write Pulse Width	t_{WP}	70	—	90	—	120	—	ns
Write Recovery Time	t_{WR}	5	—	10	—	10	—	ns
Output Disable to Output in High Z	t_{OHZ}	0	40	0	50	0	60	ns
Write to Output in High Z	t_{WHZ}	0	50	0	60	0	60	ns
Data to Write Time Overlap	t_{DW}	35	—	40	—	60	—	ns
Data Hold from Write Time	t_{DH}	5	—	10	—	10	—	ns
Output Active from End of Write	t_{OW}	5	—	10	—	10	—	ns

■ CAPACITANCE (f=1MHz, Ta=25°C)

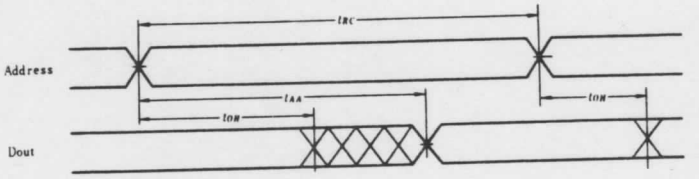
Item	Symbol	Test Conditions	typ	max	Unit
Input Capacitance	C_{in}	V_{in}=0V	3	5	pF
Input/Output Capacitance	$C_{I/O}$	$V_{I/O}$=0V	5	7	pF

■ TIMING WAVEFORM

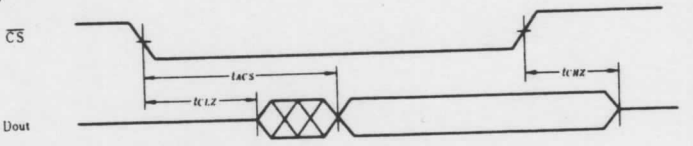
● Read Cycle (1) (1), (5)



● Read Cycle (2) (1), (2), (4), (5)

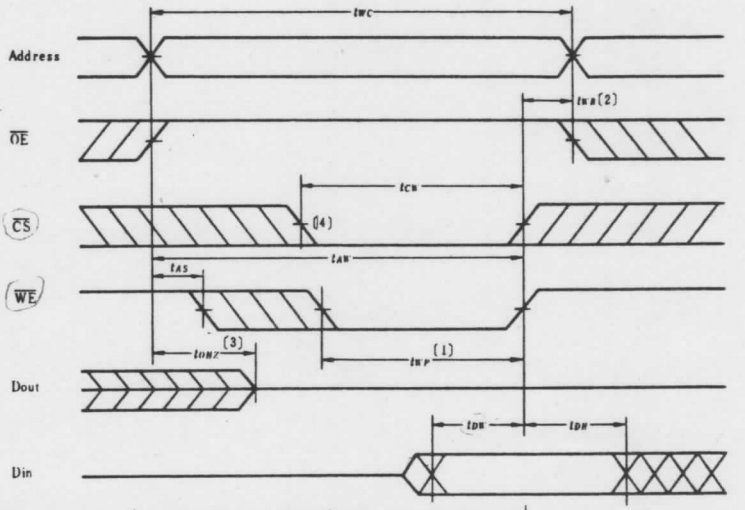


● Read Cycle (3) (1), (3), (4), (5)

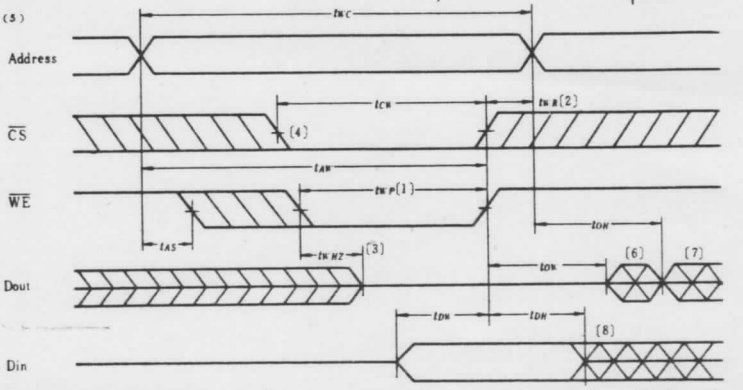


NOTES: 1. $\overline{WE}$ is High for Read Cycle.
2. Device is continuously selected, $\overline{CS}$ = V_{IL}.
3. Address Valid prior to or coincident with $\overline{CS}$ transition Low.
4. $\overline{OE}$ = V_{IL}.
5. When $\overline{CS}$ is Low, the address input must not be in the high impedance state.

● **Write Cycle (1)**



● **Write Cycle (2)** (5)



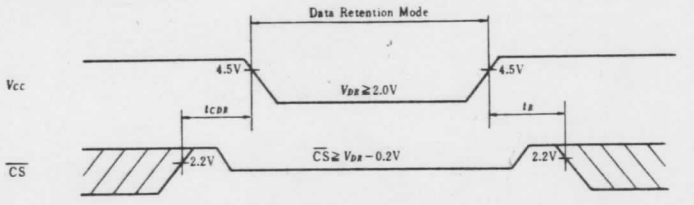
NOTES:
1. A write occurs during the overlap (t_{WP}) of a low $\overline{CS}$ and a low $\overline{WE}$.
2. t_{WR} is measured from the earlier of $\overline{CS}$ or $\overline{WE}$ going high to the end of write cycle.
3. During this period, I/O pins are in the output state so that the input signals of opposite phase to the outputs must not be applied.
4. If the $\overline{CS}$ low transition occurs simultaneously with the $\overline{WE}$ low transitions or after the $\overline{WE}$ transition, output remain in a high impedance state.
5. $\overline{OE}$ is continuously low. ($\overline{OE}$ = V_{IL})
6. D_{out} is the same phase of write data of this write cycle.
7. D_{out} is the read data of next address.
8. If $\overline{CS}$ is Low during this period, I/O pins are in the output state. Then the data input signals of opposite phase to the outputs must not be applied to them.

■ LOW Vcc DATA RETENTION CHARACTERISTICS (Ta=0 to +70°C)

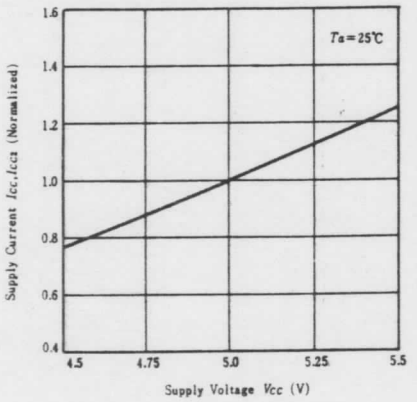
Item	Symbol	Test Conditions	min	typ	max	Unit
V_{CC} for Data Retention	V_{DR}	$\overline{CS} \geq V_{CC}-0.2V$, $V_{in} \geq V_{CC}-0.2V$ or $V_{in} \leq 0.2V$	2.0	—	—	V
Data Retention Current	I_{CCDR}**	V_{CC}=3.0V, $\overline{CS} \geq 2.8V$, $V_{in} \geq 2.8V$ or $V_{in} \leq 0.2V$	—	—	50	μA
Chip Deselect to Data Retention Time	t_{CDR}	See Retention Waveform	0	—	—	ns
Operation Recovery Time	t_R		t_{RC}**	—	—	ns

* V_{IL}=−0.3V min.
** t_{RC}=Read Cycle Time.

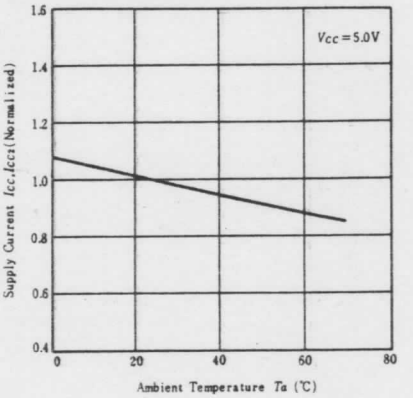
● **Low Vcc Data Retention Waveform**



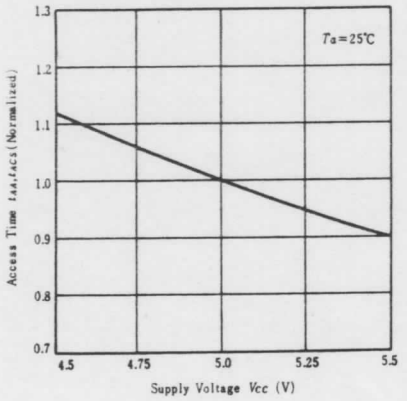
SUPPLY CURRENT vs. SUPPLY VOLTAGE



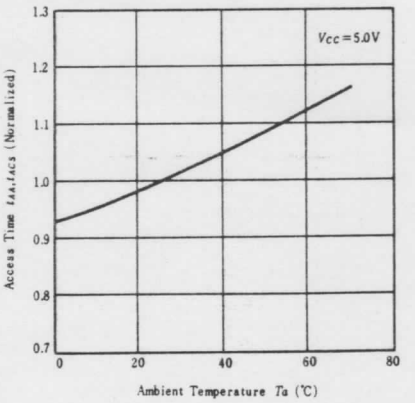
SUPPLY CURRENT vs. AMBIENT TEMPERATURE



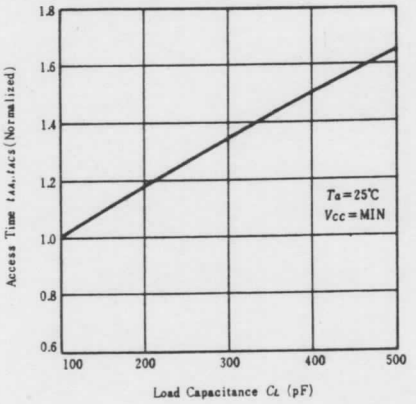
ACCESS TIME vs. SUPPLY VOLTAGE



ACCESS TIME vs. AMBIENT TEMPERATURE



ACCESS TIME vs. LOAD CAPACITANCE



SUPPLY CURRENT vs. FREQUENCY